

Listing of Claims:

The listing of claims will replace all prior versions, and listings, of claims in the application.

Claim 1 (Original): A method of illuminating a display screen of a flat panel display so as to smoothly and dynamically vary a display screen illumination level between a predetermined maximum illumination level suitable for viewing of the display screen in ambient daylight conditions and a predetermined minimum illumination level suitable for viewing of the display screen in ambient night conditions, comprising the steps of:

monitoring a level of ambient light incident on the display screen to determine a desired display screen illumination level within a range defined between the predetermined maximum and minimum illumination levels;

monitoring the current display screen illumination level and providing said monitored level to a display screen illumination level controller that is operable for illuminating the display screen at said determined desired display screen illumination level by:

varying a one-hundred-percent duty cycle fluorescent electrical control signal for operating a fluorescent lamp disposed for illuminating the display screen between a first fluorescent control signal level for illuminating the display screen at the predetermined maximum illumination level and a second fluorescent control signal level for illuminating the display screen at a predetermined transition illumination level less than the predetermined maximum illumination level but greater than the predetermined minimum illumination level and greater than a minimum fluorescent operating control signal level sufficient for maintaining continuous constant-brightness output from the fluorescent lamp at a one-hundred-percent duty cycle, so as to illuminate the display screen at the determined desired display screen illumination level when the determined

desired display screen illumination level is between said predetermined maximum illumination level and said predetermined transition illumination level;

varying an LED electrical control signal for operating at least one light emitting diode disposed for illuminating the display screen between a first LED control signal level for illuminating the display screen at the predetermined transition illumination level and a second LED control signal level for illuminating the display screen at the predetermined minimum illumination level, so as to illuminate the display screen at the desired display screen illumination level when the determined desired display screen illumination level is between said predetermined transition illumination level and said predetermined minimum illumination level;

as the desired display screen illumination level decreases to said predetermined transition illumination level, discontinuing supply of the fluorescent control signal to the fluorescent lamp to discontinue illumination output from the fluorescent lamp, supplying the LED control signal to the at least one light emitting diode, and varying the LED control signal in accordance with the monitored current display screen illumination level to illuminate the display screen at the determined desired display screen illumination level; and

as the desired display screen illumination level increases to said predetermined transition illumination level, initiating supply of the fluorescent control signal to the fluorescent lamp to initiate illumination output from the fluorescent lamp, varying the LED control signal in accordance with the monitored current display screen illumination level to assist the fluorescent tube in illuminating the display screen at the determined desired display screen illumination level as the fluorescent tube is initially

powered, and discontinuing supply of the LED control signal to the at least one light emitting diode when the monitored current display screen illumination level indicates that the illumination output of the fluorescent tube is sufficient to illuminate the display screen to the determined desired display screen illumination level.

Claim 2 (Original): Apparatus for illuminating a display screen of a flat panel display so as to smoothly and dynamically vary a display screen illumination level between a predetermined maximum illumination level suitable for viewing of the display screen in ambient daylight conditions and a predetermined minimum illumination level suitable for viewing of the display screen in ambient night conditions, said apparatus comprising:

an ambient light sensor for monitoring a level of ambient light incident on the display screen to determine a desired display screen illumination level within a range defined between the predetermined maximum and minimum illumination levels;

a display illumination level sensor for monitoring the current display screen illumination level;

a fluorescent lamp disposed for illuminating the display screen;

at least one light emitting diode disposed for illuminating the display screen;

a display screen illumination level controller connected to the ambient light sensor for determining from the monitored level of incident ambient light a desired display screen illumination level within a range defined between the predetermined maximum and minimum illumination levels, and to the display illumination level sensor for receiving the monitored current display screen illumination level, and connected to the fluorescent tube and to the at least one light emitting diode, said controller being operable for illuminating the display screen at the determined desired display screen illumination level by:

varying a one-hundred-percent duty cycle fluorescent electrical control signal for operating the fluorescent lamp between a first fluorescent control signal level for illuminating the display screen at the predetermined maximum illumination level and a second fluorescent control signal level for illuminating the display screen at a predetermined transition illumination level less than the predetermined maximum illumination level but greater than the predetermined minimum illumination level and greater than a minimum fluorescent operating control signal level sufficient for maintaining continuous constant-brightness output from the fluorescent lamp at a one-hundred-percent duty cycle, so as to illuminate the display screen at the determined desired display screen illumination level when the determined desired display screen illumination level is between said predetermined maximum illumination level and said predetermined transition illumination level;

varying an LED electrical control signal for operating the at least one light emitting diode between a first LED control signal level for illuminating the display screen at the predetermined transition illumination level and a second LED control signal level for illuminating the display screen at the predetermined minimum illumination level, so as to illuminate the display screen at the desired display screen illumination level when the determined desired display screen illumination level is between said predetermined transition illumination level and said predetermined minimum illumination level;

as the desired display screen illumination level decreases to said predetermined transition illumination level, discontinuing supply of the fluorescent control signal to the fluorescent lamp to discontinue illumination output from the

fluorescent lamp, supplying the LED control signal to the at least one light emitting diode, and varying the LED control signal in accordance with the monitored current display screen illumination level to illuminate the display screen at the determined desired display screen illumination level; and

as the desired display screen illumination level increases to said predetermined transition illumination level, initiating supply of the fluorescent control signal to the fluorescent lamp to initiate illumination output from the fluorescent lamp, varying the LED control signal in accordance with the monitored current display screen illumination level to assist the fluorescent tube in illuminating the display screen at the determined desired display screen illumination level as the fluorescent tube is initially powered, and discontinuing supply of the LED control signal to the at least one light emitting diode when the monitored current display screen illumination level indicates that the illumination output of the fluorescent tube is sufficient to illuminate the display screen to the determined desired display screen illumination level.

Claim 3 (previously presented): Apparatus for illuminating a display screen of a flat panel display so as to smoothly and dynamically vary a display screen illumination level between a predetermined maximum illumination level suitable for viewing of the display screen in ambient daylight conditions and a predetermined minimum illumination level suitable for viewing of the display screen in ambient night conditions, said apparatus comprising:

a display illumination level sensor for monitoring a current display screen illumination level;

a fluorescent lamp disposed for operatively illuminating the display screen at display screen illumination levels in a first display screen illumination range defined between the

predetermined maximum illumination level and a predetermined transition illumination level less than the predetermined maximum illumination level but greater than the predetermined minimum illumination level;

at least one light emitting diode disposed for operatively illuminating the display screen at display screen illumination levels in a second display screen illumination range defined between the predetermined transition illumination level and the predetermined minimum illumination level; and

a display screen illumination level controller connected to the display illumination level sensor, to the fluorescent lamp and to the at least one light emitting diode and operable for controlling operation of the fluorescent lamp and the at least one light emitting diode to smoothly and dynamically vary the display screen illumination selectively between the predetermined maximum and minimum illumination levels so as to illuminate the display screen at a present desired display screen illumination level by:

varying a fluorescent electrical control signal for operating the fluorescent lamp between a first fluorescent control signal level for illuminating the display screen at the predetermined maximum illumination level and a second fluorescent control signal level for illuminating the display screen at the predetermined transition illumination level, so as to illuminate the display screen using said operating fluorescent lamp at a display screen illumination level within said first display screen illumination range;

discontinuing supply of the fluorescent electrical control signal to the fluorescent lamp when the present desired display screen illumination level is varied from said first display screen illumination range to said second display screen illumination

range so as to shut-off the fluorescent lamp in said second display screen illumination range;

initiating supply of the fluorescent electrical control signal to the fluorescent lamp when the present desired display screen illumination level is varied from said second display screen illumination range to said first display screen illumination range so as to power-on the fluorescent lamp for predeterminedly illuminating the display screen in said first display screen illumination range;

varying an LED electrical control signal for operating the at least one light emitting diode between a first LED control signal level for illuminating the display screen at the predetermined transition illumination level and a second LED control signal level for illuminating the display screen at the predetermined minimum illumination level, so as to illuminate the display screen using said at least one light emitting diode at a display screen illumination level within said second display screen illumination range; and

further varying the LED electrical control signal for predeterminedly illuminating the display screen at and proximate the predetermined transition illumination level to one of

- (i) decrease the LED electrical control signal in accordance with the monitored current display screen illumination level and the present desired display screen illumination level to correct for fluorescent lamp persistence at fluorescent lamp shut-off, and
- (ii) increase the LED electrical control signal in accordance with the monitored current display screen illumination level and the present desired display screen

illumination level to correct for fluorescent lamp start-up delays and fluorescent lamp start-up illumination level variations when the fluorescent lamp is initially powered on,
to thereby maintain an uninterrupted smooth variation in the display screen illumination level as the display screen illumination level is dynamically varied between the predetermined maximum display screen illumination level and the predetermined minimum display screen illumination level.

Claim 4 (previously presented): A method of illuminating a display screen of a flat panel display so as to smoothly and dynamically vary a display screen illumination level between a predetermined maximum illumination level suitable for viewing of the display screen in ambient daylight conditions and a predetermined minimum illumination level suitable for viewing of the display screen in ambient night conditions, comprising the steps of:

monitoring a current display screen illumination level;
providing a fluorescent lamp disposed for operatively illuminating the display screen at display screen illumination levels in a first display screen illumination range defined between the predetermined maximum illumination level and a predetermined transition illumination level less than the predetermined maximum illumination level but greater than the predetermined minimum illumination level;

providing at least one light emitting diode disposed for operatively illuminating the display screen at display screen illumination levels in a second display screen illumination range defined between the predetermined transition illumination level and the predetermined minimum illumination level; and

controlling operation of the fluorescent lamp and the at least one light emitting diode to smoothly and dynamically vary the display screen illumination selectively between the predetermined maximum and minimum illumination levels so as to illuminate the display screen at a present desired display screen illumination level by:

varying a fluorescent electrical control signal for operating the fluorescent lamp between a first fluorescent control signal level for illuminating the display screen at the predetermined maximum illumination level and a second fluorescent control signal level for illuminating the display screen at the predetermined transition illumination level, so as to illuminate the display screen using the operating fluorescent lamp at a display screen illumination level within said first display screen illumination range;

discontinuing supply of the fluorescent electrical control signal to the fluorescent lamp when the present desired display screen illumination level is varied from said first display screen illumination range to said second display screen illumination range so as to shut-off the fluorescent lamp in said second display screen illumination range;

initiating supply of the fluorescent electrical control signal to the fluorescent lamp when the present desired display screen illumination level is varied from said second display screen illumination range to said first display screen illumination range so as to power-on the fluorescent lamp for predeterminedly illuminating the display screen in said first display screen illumination range;

varying an LED electrical control signal for operating the at least one light emitting diode between a first LED control signal level for illuminating the display screen at the predetermined transition illumination level and a second LED control signal

level for illuminating the display screen at the predetermined minimum illumination level, so as to illuminate the display screen using the at least one light emitting diode at a display screen illumination level within said second display screen illumination range; and

further varying the LED electrical control signal for predeterminately illuminating the display screen at and proximate the predetermined transition illumination level to one of

(i) decrease the LED electrical control signal in accordance with the monitored current display screen illumination level and the present desired display screen illumination level to correct for fluorescent lamp persistence at fluorescent lamp shut-off, and

(ii) increase the LED electrical control signal in accordance with the monitored current display screen illumination level and the present desired display screen illumination level to correct for fluorescent lamp start-up delays and fluorescent lamp start-up illumination level variations when the fluorescent lamp is initially powered on,

to thereby maintain an uninterrupted smooth variation in the display screen illumination level as the display screen illumination level is dynamically varied between the predetermined maximum display screen illumination level and the predetermined minimum display screen illumination level.

Claim 5 (new): A method in accordance with claim 1, wherein said step of monitoring the current display screen illumination level comprises optically monitoring the current display screen illumination level.

Claim 6 (new): A method in accordance with claim 1, wherein said step of monitoring the current display screen illumination level comprises optically monitoring the current display screen illumination level using a photosensor.

Claim 7 (new): An apparatus for illuminating a display screen in accordance with claim 2, wherein said display illumination level sensor comprises an optical illumination level sensor operable for optically monitoring the current display screen illumination level.

Claim 8 (new): An apparatus for illuminating a display screen in accordance with claim 2, wherein said display illumination level sensor comprises a photosensor for optically monitoring the current display screen illumination level.

Claim 9 (new): An apparatus for illuminating a display screen in accordance with claim 3, wherein said display illumination level sensor comprises an optical illumination level sensor operable for optically monitoring the current display screen illumination level.

Claim 10 (new): An apparatus for illuminating a display screen in accordance with claim 3, wherein said display illumination level sensor comprises a photosensor for optically monitoring the current display screen illumination level.

Claim 11 (new): A method in accordance with claim 4, wherein said step of monitoring the current display screen illumination level comprises optically monitoring the current display screen illumination level.

Claim 12 (new): A method in accordance with claim 4, wherein said step of monitoring the current display screen illumination level comprises optically monitoring the current display screen illumination level using a photosensor.